

# POSTFIRE RECOVERY OF CREOSOTE BUSH SCRUB VEGETATION IN THE WESTERN COLORADO DESERT

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## ABSTRACT

Postfire recovery of three desert shrubs, *Larrea tridentata*, *Hymenoclea salsola*, and *Opuntia echinocarpa* was examined five years after a fire in the Snow Creek area of southern California. *Larrea tridentata* resprouted and had nearly regained its estimated former cover. *O. echinocarpa* excepted, the community has shown substantial recovery. The upper distribution of these desert shrubs may be controlled in part by their susceptibility to periodic fire.

Desert vegetation of southern California is characterized by low biomass with substantial bare space between individual shrubs. Thus it is not surprising that wildfires are infrequent. As a result, remarkably little is known about the postfire recovery of such vegetation.

In early July, 1973, a brushfire spread along the steep north face of Mt. San Jacinto, burning about 3725 ha of timber and chaparral (U.S. Forest Service, undated). Along its northern perimeter the fire moved downslope onto the western edge of the Colorado Desert across an alluvial fan west of Snow Creek village (Fig. 1) where it was sustained by an unusually dense herb layer arising from the previous winter rains. Approximately 65 ha of desert scrub vegetation dominated by *Larrea tridentata*, *Hymenoclea salsola*, and *Opuntia echinocarpa* were incinerated before the fire's advance was halted by firemen near the 375 m contour line. The exact border is thus an artificial line rather than a function of fuel. In this paper, we assess postfire recovery of the dominant shrubs in this burned area by comparison with adjacent unburned stands. Also we attempt to compare shrub coverage before and after fire in the burned area.

## METHODS

Snags of *L. tridentata* and charred *O. echinocarpa* individuals allowed us to reconstruct the previous canopy extent. Many *H. salsola* plants were incinerated to ground level. Line intercepts and belt transects were used to sample both burned and unburned portions of the alluvial fan in April, 1978. Line intercepts were used for rapid and

accurate estimation of percent cover (Bauer, 1943) and belt transects were used to estimate plant frequencies.

Four 100-m line intercepts were extended at random intervals perpendicular to a 100-m baseline oriented parallel to contour in both study sites (Fig. 1). Both living and dead shrubs were recorded. Dead material in the unburned portion was not appreciable. Additionally in the sample sites the present ground cover of living herbs in the burned section was compared to the unburned section. Foliar cover of herbaceous species was visually estimated by three observers for both burned and unburned sites with average values recorded for the most common species. The relative similarity of the ephemeral vegetation on both sites was evaluated by calculating the percentage similarity (Czekanowski, 1909) and coefficient of community (Sørensen, 1948).

Two belt transects, 325 and 200 m in length, were extended up the alluvial fan from the unburned into the burned portions. Presence of perennial species was recorded above each square meter. Community and species nomenclature follow Munz (1974).

## RESULTS

Table 1 indicates the percent frequency of occurrence of perennial plants in the belt transects. It also shows the percent cover of the three dominant shrubs in the burned and unburned sites. These data reveal that the estimated preburn cover of all three differed from that of the unburned site. Prior to the fire, *O. echinocarpa* and *H. salsola* occupied more area in the burned section than in the unburned section, whereas the reverse was true of *L. tridentata*. The lower *L. tridentata* cover in the burned site is probably best attributed to the ecocline nature of the alluvial fan vegetation. Prior to the fire, it extended no more than a few hundred meters above the study site where *Encelia farinosa* became dominant. Cover decreases in *L. tridentata* shrubs have also been observed along upper elevations of Colorado Desert (Burk, 1977) and Arizona bajadas (Barbour and Diaz, 1973). In the latter study, substantial patchy changes in floristic composition occurred with lateral displacement along a bajada, a condition we also noticed. Because *H. salsola* was commonly incinerated to ground level, its preburn cover was probably underestimated.

Comparison of current and estimated prefire cover within the burned sample area shows that *O. echinocarpa* has only 27 percent of its former cover. Farther up the alluvial fan, *O. echinocarpa* mortality was nearly complete, probably owing to denser vegetation and more intense fire. In the burned section, *L. tridentata* successfully resprouted and had regained nearly its estimated former cover within five years. *Hymenoclea salsola* generally reseeded and appeared to exceed its former cover. Little difference in ephemeral vegetation ex-

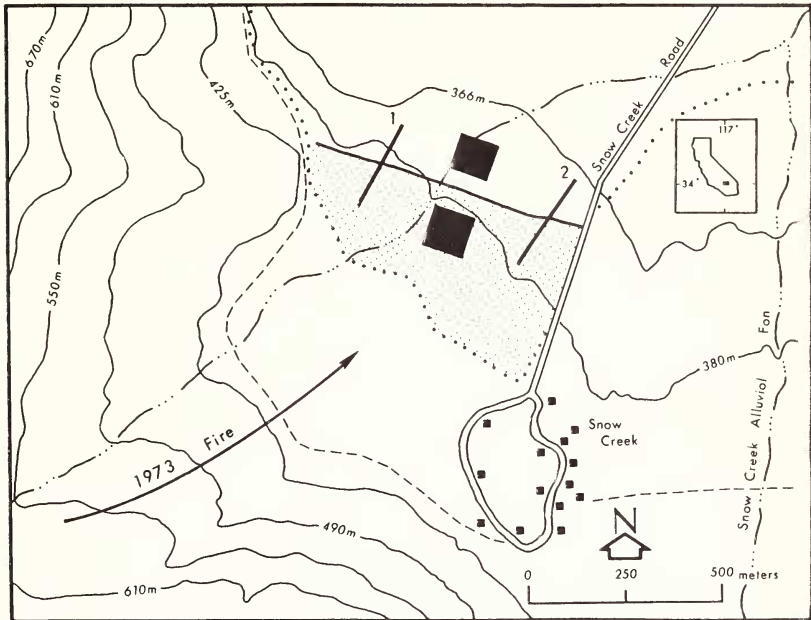


FIG. 1. Location of study area near Snow Creek (Riverside Co.) in southern California. Stippled area denotes burned creosote bush scrub. Dotted line approximates the upper elevational extent of *Larrea tridentata* as does the dashed line for *Opuntia echinocarpa*. Vegetation upslope from dashed line is dominated by coastal sage scrub species admixed with some desert shrubs, and, at higher elevations, chaparral shrubs. Numbered lines straddling fire border represent belt transects; darkened squares indicate line intercept sampling sites. Arrow shows direction in which 1973 fire burned.

isted between the two sites. Species found were *Euphorbia albomarginata* (30 percent cover in unburned area, 30 percent in burned area); *Erodium cicutarium* (6, 10); *Schismus barbatus* (6, 5); *Crassula erecta* (3, 3); and *Bromus rubens* (2, 1). The following species had 0-1 percent cover in both areas: *Malacothrix glabrata*, *Lupinus bicolor*, *Cryptantha intermedia*, *Lotus tomentellus*, *Lasthenia chrysostoma*, and *Camissonia pallida*. The coefficient of community (0.82) and the percentage similarity (84 percent) between the sites were both fairly high.

#### DISCUSSION

The portion of the California fire that extended onto the alluvial fan in the Snow Creek area was severe enough to defoliate nearly all creosote bushes, although most resprouted. *Opuntia echinocarpa* survived by directly tolerating the fire. Living individuals bore scorched tissue five years later. No regeneration from fallen unburned joints was apparent. Tratz and Vogl (1977) found that *O. acanthocarpa*, a

TABLE 1. FREQUENCY OF PERENNIAL PLANTS ACROSS BURN BOUNDARY IN SNOW CREEK DRAINAGE. Data (percents) are based on two belt transects. Percent foliar cover for the dominant shrubs (based on four line intercepts in each study site) is given in parentheses.

Species	Unburned		Burned	
	Living	Dead	Living	Dead
<i>Larrea tridentata</i>	24 (10)	0 (0)	8 (2)	3 (0.4)
<i>Opuntia echinocarpa</i>	6 (4)	1 (0)	6 (2)	11 (4)
<i>Hymenoclea salsola</i>	4 (5)	0 (0)	19 (10)	3 (5)
<i>Encelia farinosa</i>	0.6	0	1.1	0
<i>Prosopis glandulosa</i>	5.1	0	0	0
<i>Mirabilis tenuiloba</i>	0	0	0.8	0
<i>Stillingia linearifolia</i>	0	0	0.5	0
<i>Salvia mellifera</i>	0	0	0.5	0

closely related species, had 25 percent of its individuals resprouting one year after a fire on burned portions of Anza-Borrego Desert State Park, San Diego County. *Opuntia acanthocarpa* displayed the poorest recovery of sampled plants following that fire.

*Larrea tridentata* and some *H. salsola* plants have resprouting ability comparable to some chaparral plants. The abundance of *H. salsola* in the burned site may reflect an ability for rapid, weedy colonization. Other investigators have tentatively categorized *H. salsola* as a relatively short-lived shrub occurring in naturally disturbed areas in creosote bush scrub. It is also observed as a pioneer in more severely disturbed areas such as those affected by pipeline construction, power transmission lines, and off-road vehicles (Davidson and Fox, 1974; Vasek, Johnson, and Eslinger, 1975; Vasek, Johnson, and Yonkers, 1975).

No fires have occurred on the study area in historic times. In 1911, a fire spread downward from the mountains to the uppermost extent of the alluvial fan, whereas in 1941 the ridge immediately west of the fan burned (U.S. Forest Service, undated). It is of interest that the lower perimeter of the 1911 fire roughly coincides with the upper elevational extent of *O. echinocarpa* on the alluvial fan. Lack of growth rings in *Opuntia* species precludes annular dating, but *O. echinocarpa* specimens taller than about 0.7 m may be 25 years old or more (Park Nobel, pers. comm., 1980). Its average height in our study area was about 1 m, implying that many of the individuals may have been quite old. The decreased survival rate of *O. echinocarpa* associated with increasingly denser vegetation found with elevational increase suggests burning intensity may set additional limits to its distribution.

Data from near Tucson, Arizona, indicate that the survival frequency of *L. tridentata* after controlled burning is directly propor-

tional to fire intensity and season (White, 1968; Cable, 1972). Controlled burns in June of sparse cover of native grasses, augmented by the addition of straw, produced up to 100 percent mortality, whereas lower intensity burns on native grasses are much less damaging. Jumping cholla (*Opuntia fulgida*) and cane cholla (*O. spinosior*) are also susceptible to incineration (Humphrey, 1949, 1974; Reynolds and Bohning, 1956; Cable, 1967, 1972). Cattlemen have long used fire to help control cholla and mesquite.

The intergradation of the creosote bush scrub into the higher elevation shrub communities reflects physiologic tolerance along a topographic moisture gradient. Beatley (1974, p. 260) suggested that the northern boundary and upper elevational limits of *L. tridentata* in southern Nevada "are determined primarily by rainfall in excess of a critical amount, and the rainfall regimes over probably a very long time." She estimated that amount to be 183 mm. The upper elevational distribution of *L. tridentata* and *O. echinocarpa* also may be controlled locally by their susceptibility to periodic and intense fire. Dry fuel values exceeding critical levels could result in large scale mortality. We suggest that in the desert scrub-coastal sage scrub ecotone, the intensity and periodicity of wildfires may be additional factors to physiologic tolerance in limiting the distribution and abundance of some desert perennials.

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## ANNOUNCEMENT

### PAPERS IN WESTERN PLANT ECOLOGY

A symposium in honor of the retirement of Professor Jack Major will be presented on Friday, 29 May 1981. It will be held at the University of California, Davis, campus in Memorial Union, Room II (upstairs), from 9 a.m. to 5 p.m. Approximately 12 speakers will present research or overview papers on "Western Plant Ecology." There will be no registration fee, but participants must provide their own lunches.

The symposium is being co-sponsored by the California Botanical Society; the UC Davis Institute of Ecology; and the Botany Department, UC Davis.

Speakers and tentative titles are as follows: *G. L. Stebbins*, Floristic affinities of the high Sierra of California; *D. J. Parsons*, Vegetation management and research in Sequoia and Kings Canyon National Parks; *J. L. Vankat*, Vegetation classification and analyses in Sequoia National Park; *P. W. Rundel*, Nutrient cycling and chaparral in Sequoia and Kings Canyon National Parks; *N. Benedict*, Mountain meadows: stability and change; *M. B. Morgan*, Vegetation of the Rae Lakes Basin, southern Sierra Nevada; *D. I. Axelrod*, Age and origin of the Monterrey endemic area; *J. R. Griffin*, Pine seedlings, native herbs, and annual ryegrass on the Marble-Cone burn, Santa Lucia Mountains; *J. A. Neilson*, Distribution, ecology, and proposed revision of the *Strep-tanthus morrisonii* complex; *R. Macdonald*, Patterns of xylem sap tension and conductance of foothill woodland vegetation types near Lake Berryessa; *R. Gankin*, Ecology and land use planning in San Mateo County; *J. H. Burk*, Phenology, germination, and survival of ephemerals in Deep Canyon; *C. B. Davis*, Seed banks and vegetation history in prairie wetlands.

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